

REMARKS/ARGUMENTS

Overview of the invention :

The invention discloses a liftoff resist, formed from a single material, and a method to manufacture it. Conventional photoresist (positive or negative) is first patterned in the conventional way. Then, the top surface (only) is exposed to a beam of ions **whose energy is too low to cause sputtering**. Said ions penetrate a short distance beneath the photoresist surface, forming there a hardened layer. This is followed by exposure to ozone which erodes all exposed photoresist surfaces except the aforementioned hardened layer, causing the latter to overhang the unhardened layer beneath it, thereby rendering it suitable for subsequent use as a liftoff mask.

Reconsideration is requested of the rejection of claims 1-2, 5-6, and 8 under 35 U.S.C. 103, as being unpatentable over Yamada et al. in US 4,904,619 in view of Bloomstein et al. in US 6.833.234.

Examiner's position continues to be that the prior art teaches ion bombardment of a single layer of patterned photoresist by ions that harden its surface but are of sufficiently low energy to not remove any material from said photoresist layer. A sub-process of this type is a key feature of the present invention, appearing, for example, in our claim 1 (as currently amended), part of which reads as follows (emphasis added):

depositing a single layer of photoresist on a substrate;

exposing and developing said photoresist layer thereby forming a photoresist pattern having sidewalls and an upper surface;

irradiating said upper surface with an ion beam having a direction parallel to said

sidewalls, **said ion beam comprising ions whose energy is too low to sputter said layer of photoresist;**

maintaining said ion beam irradiation for a time period whereby a hardened layer is formed that extends a distance downwards from said upper surface, all remaining photoresist being unhardened;

then exposing said photoresist pattern to ozone whereby said sidewalls are eroded and said hardened layer is unchanged so that the hardened layer overhangs the unhardened layer

The prior art in question on which examiner relies is He (US 2004/0018742) paragraph [0052]. We respectfully disagree with examiner's argument that said paragraph in He teaches bombardment by ions, whose energy is too low to sputter a layer of photoresist, for the following reasons:

(1) He teaches use of a D.C. substrate bias to achieve ion bombardment of his photoresist. This implies that his photoresist must be electrically conductive. While He is silent in [0052] as to how he achieves this we note that in [0006] he mentions adding silicon to photoresist. But regardless of how He sustains his D.C. bias, this is a different sub-process from the one claimed in the present invention which is bombardment by an ion beam.

(2) In [0052] He states " The addition of the inert gas also help to dilute the O₂ and/or N₂ components in the process gas to reduce **the amount of etching** into the lower resist layer 120." (emphasis added). This shows that some material is removed as a consequence of He's ion bombardment process.

(3) He's sub-process requires a bilayer photoresist as its starting point. The principal motivation for developing the present invention has been to be able to use a single layer of photoresist for liftoff patterning. See for example in our specification:

"A further object of at least one embodiment of the present invention has been that said included liftoff process require the deposition of only a single layer of photoresist".

It follows that one skilled in the art would not be motivated to apply any of He's teachings when trying to find a way to use a single photoresist layer in liftoff mode.

In summary, He teaches a method to improve a bilayer liftoff resist by exposing said resist to a gas discharge generated plasma and then giving the resist a D.C. bias relative to the plasma. He adds argon to the gas so as to reduce the amount of etching during this process.

In view of the arguments presented above, applicants respectfully request that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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